

# Occurrences of disasters involving rains in the state of Tocantins

Andressa Vieira da Cruz\*, Guilherme Augusto Bastos Felix, Alesi Teixeira Mendes

\*Corresponding Author

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**Keywords—** Natural Disaster; Flooding;  
Flooding; Flood.

**Abstract—** The Natural disasters are the result of the impact of an extreme or intense natural phenomenon on a social system. In Brazil, the most common types of disasters are related to lack or excess water, such as drought, floods, floods, floods. The agencies responsible for monitoring natural disasters in Brazil are the National Secretariat for Protection and Civil Defense (SEDEC), the Ministry of Regional Development, representative of SINPDEC - National System of Protection and Civil Defense. The Integrated Disaster Information System - S2ID integrates several SEDEC products, and aims to qualify and provide transparency to risk and disaster management in Brazil. It also has the National Center for Monitoring and Warning of Natural Disasters (Cemaden), which works in partnership with other institutions and allows the early sending of natural disaster alerts to risk areas located in all regions of the national territory.

## I. INTRODUCTION

Natural phenomena are present on planet Earth from the beginning, they act according to the natural laws of our planet, but with the emergence of homo-sapiens, these phenomena could then cause damage to the societies of our species, and when these phenomena cause harm to us, these become called natural disasters.

Natural disasters in general can be of biological, geophysical, hydrological, meteorological, climatological origin, or even in the worst situations a combined of one or more types, causing damage to health, material damage or even the loss of human lives, being in Brazil the most common to occur climatological, hydrological or meteorological disasters, involving lack or excess water.

This article aims to identify events of floods, floods and floods, in the S2ID - National Disaster Information System for the state of Tocantins, mapping the municipalities with the highest occurrences, and also with higher risks of future occurrences of new disasters.

## II. BIBLIOGRAPHIC REVIEW

### 2.1 NATURAL DISASTERS

The National Institute of Space Research (INPE) defines natural disasters as "a result of the impact of an extreme or intense natural phenomenon on a social system, and that causes serious damage and damage that exceeds the ability of those affected to live with the impact".

The Institute proposes the following classification for natural disasters: biological (epidemics, insect infestations, animal attacks); geophysicists (earthquakes, volcanoes, mass movement without water); (droughts, extreme temperatures, fires); (floods, mass movements with water); weather (storms) [1].

According to [2], in order for a natural disaster to occur, a combination of four factors is necessary: the occurrence of a natural threat; an exposed population; the conditions of social and environmental vulnerability of this population; and insufficient capacities or measures to reduce potential risks and damage to the health of the population. The threat generated comes from the quality of physical processes that are generated by the dynamics of nature, according to its

geographical location, magnitude, intensity, frequency and probability.

### 2.1.1 DISASTERS AND CRITICAL EVENTS INVOLVING RAINS

NOBRE, 2017) cites as the most common elements that trigger natural disasters in Brazil:

Heavy and prolonged rains, storms, gales, hail, droughts, extreme air temperatures and humidities and hangovers, which cause landslides on hillsides, floods, floods, floods, collapse of subsistence crops, vegetation fires, coastal erosion, acute episodes of water and air pollution, water supply collapses and epidemics.

In Brazil, most of these disasters are associated with lack of water, such as drought, or excess of it, such as heavy rains, which generate floods [3].

"The terms associated with floods are: flood, flood, flood, gradual flooding, flash flooding, flooding, riverside flooding, urban floods, flash floods, and more [4]."

The [5], defines as Flood, when the water flows in its course reach such magnitude that they can overcome the discharge capacity of the gutter and extravasate to marginal areas, these being the areas that receive these excess waters, and are called as floodplain, floodplain or larger bed. Floodism is defined as concentrated surface flow of water, and with high transport energy. And floods, also called flooding, is given as the temporary elevation of the water level in a drainage channel due to increased flow or discharge, in the case of floods the water does not go out, as occurs in floods.

When areas occupied by the population, whether for housing, commerce, industry, transport, and other urban uses, are hit by a flood, this flood is called Urban Flood also defines the concept of Riverside Flooding, this occurs when the excess of the volume of water that cannot be drained occupies the floodplain flooding according to the topography of the areas near the rivers [6]

### 2.2 THE NATIONAL DISASTER INFORMATION SYSTEM

In Brazil, the National Secretariat for Protection and Civil Defense (SEDEC), an agency of the Ministry of Regional Development, is the body responsible for coordinating civil protection and defense actions throughout the national territory, and is a representative of the Central Body of SINPDEC - National System of Protection and Civil Defense [7].

The National System of Protection and Civil Defense (SINPDEC) is composed of organs and entities of the federal public administration, the States, the Federal District and municipalities and public and private entities of

significant action in the area of protection and civil defense. SINPDEC will be able to mobilize civil society to act in a state of emergency or a state of public calamity, coordinating logistical support for the development of civil protection and defense actions [7].

The Integrated Disaster Information System - S2ID integrates several products of the National Secretariat of Protection and Civil Defense - SEDEC, with the objective of qualifying and giving transparency to risk and disaster management in Brazil [8].

In S2ID, there is a fully computerized process where it is possible to record disasters that occurred in the municipality/state, consult and monitor the processes of federal recognition of emergency situation or state of public calamity; consult and monitor the processes of transferring resources to response actions; consult and monitor the processes of transferring resources to reconstruction actions and seek information on occurrences and risk and disaster management based on official data sources [8].

The S2ID also has the PLANCON Module - Municipal Contingency Plans, for the preparation of contingency plans of the municipalities and the possibility of identification by the whole society, of the municipalities in Emergency Situation and Public Calamity State recognized by the Secretariat [8].

### 2.3 SUSTAINABLE DEVELOPMENT GOALS

According to the 2030 Agenda Platform, in New York, UN member states met and adopted the document: "Transforming Our World: The 2030 Agenda for Sustainable Development", where they pledged to take bold and transformative measures to promote sustainable development over the next 15 years without leaving anyone behind [9].

This document consists of a Declaration, in a table of results, the 17 SDS – Sustainable Development Goals and its 169 goals, in a section on means of implementation and global partnerships, as well as a roadmap for monitoring and review. The SDGs are the core of the Agenda and should be achieved by the year 2030, they are integrated and indivisible, and blend, in a balanced way, the three dimensions of sustainable development: economic, social and environmental [9].

Among the 17 objectives, number 13 is titled "Action Against Global Climate Change", and aims to take urgent action to combat climate change and its impacts. According to the [10], goal 13.1 was completed: Strengthening resilience and adaptability to risks related to climate and natural disasters in all countries, which has as indicators: 13.1.1 Number of deaths, missing persons and people directly affected attributed to disasters per 100,000

inhabitants; 13.1.2 Number of countries adopting and implementing national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030; 13.1.3 Proportion of local governments adopting and implementing local disaster risk reduction strategies in line with national disaster risk reduction strategies [10].

## 2.4 NATIONAL DISASTER PREVENTION PROGRAMS

According to [11], "natural disasters occur in regions where populations are most exposed and vulnerable to extreme climate and hydrometeorological events."

From the disasters that occurred in the second half of the first decade of the 21st century, it became indispensable to have an alert system to deal with natural disasters, until then no body of the federal sphere monitored these processes in an integrated and interdisciplinary manner, so government actions were limited to mitigating the consequences of natural disasters [11].

In July 2011, the National Center for Monitoring and Warning of Natural Disasters (Cemaden) was created, by Presidential Decree No. 7,513, an agency linked to the Ministry of Science, Technology, Innovations and Communications (MCTIC).

Cemaden operates 24 hours a day, without interruption adopts a specialized technical-scientific structure, developing scientific, technological and innovation capacity to continuously improve the alerts of natural disasters and has as main objective of the Institution to carry out the monitoring and issue alerts of natural disasters that support safeguarding lives and reduce the social, environmental and economic vulnerability arising from these events. Cemaden works in partnership with other institutions to complement the network of monitoring tools, and the results of research and tools developed by cemaden's network allow the early sending of natural disaster alerts to risk areas located in all regions of the national territory [12].

## III. MATERIALS AND METHODS

Develop a bibliographic research on Natural Disasters

and the National Programs for Disaster Prevention and how these programs relate to the proposals of the UN SDS13.

Search on websites of the Federal Government of Brazil, the Ministry of Regional Development on the programs in practice that aim to monitor and prevent natural disasters. Also research the proposal of the 17 SDGs – Sustainable Development Goals, present in the UN 2030 agenda, and collect data on the progress of objective number 13 in Brazil.

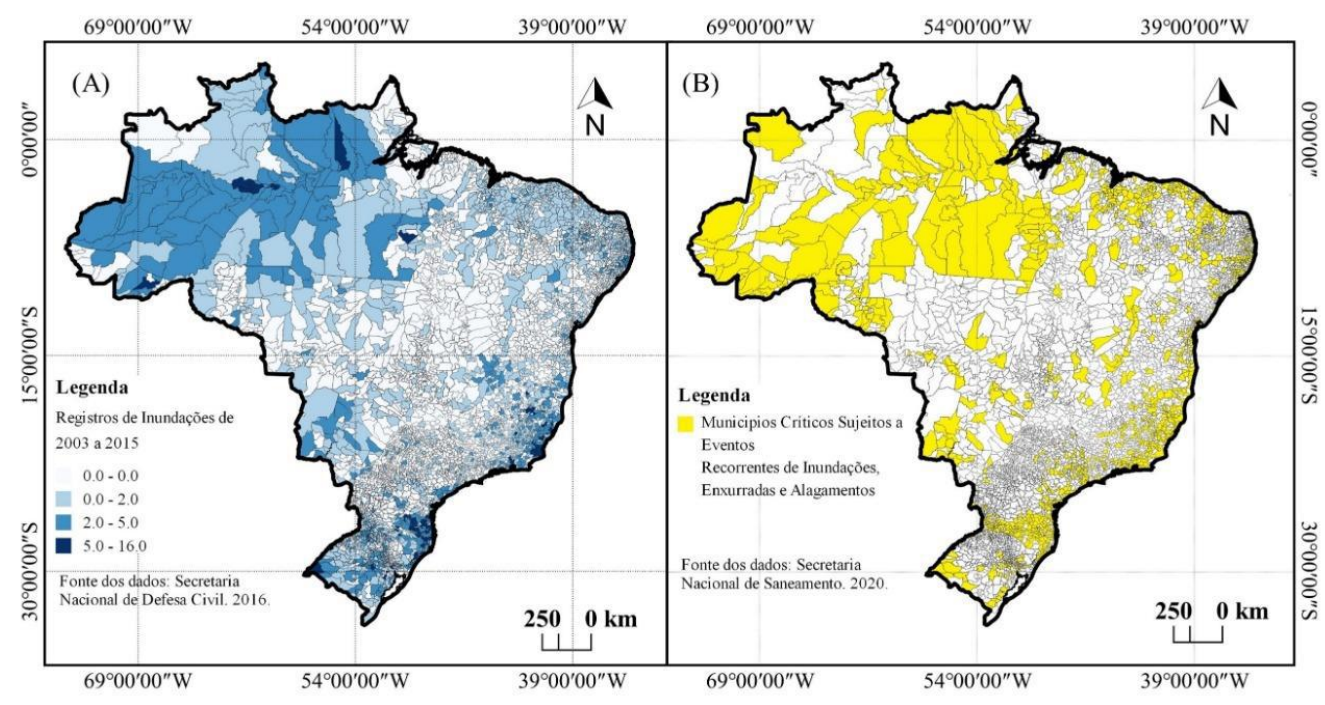
Search the SEDEC - National Secretariat for Protection and Civil Defense, and select data of floods, floods and floods, by type of disaster and document, of the municipalities of Tocantins, data taken from the disaster information system, S2ID and SNIS in the rainwater module for Tocantins; Filtered for Tocantins, types of events, types of documents; each year with available data; the data were tabulated using the Excel program for analysis. Exploratory analysis of the data and application of statistical methods, to analyze the periods and places of higher incidences of hydrological disasters, also the means of communication by which it was cataloged.

Finally, in order to allow a spatialized analysis of the information, these data were georeferenced and associated with digital files structured in GIS, available in the Geographic Database of the State of Tocantins.

Search the SEDEC - National Secretariat for Protection and Civil Defense, and select data of floods, floods and floods, by type of disaster and document, of the municipalities of Tocantins, data taken from the disaster information system, S2ID.

## IV. RESULTS AND DISCUSSION

In the map below, made available via the National Sanitation Information System (SNIS), it is possible to observe the regions with the highest number of flood records throughout Brazil between 2003 and 2015, as well as critical municipalities subject to recurrent events of floods and floods.



#### 4.1 S2ID - NUMBER OF EVENTS

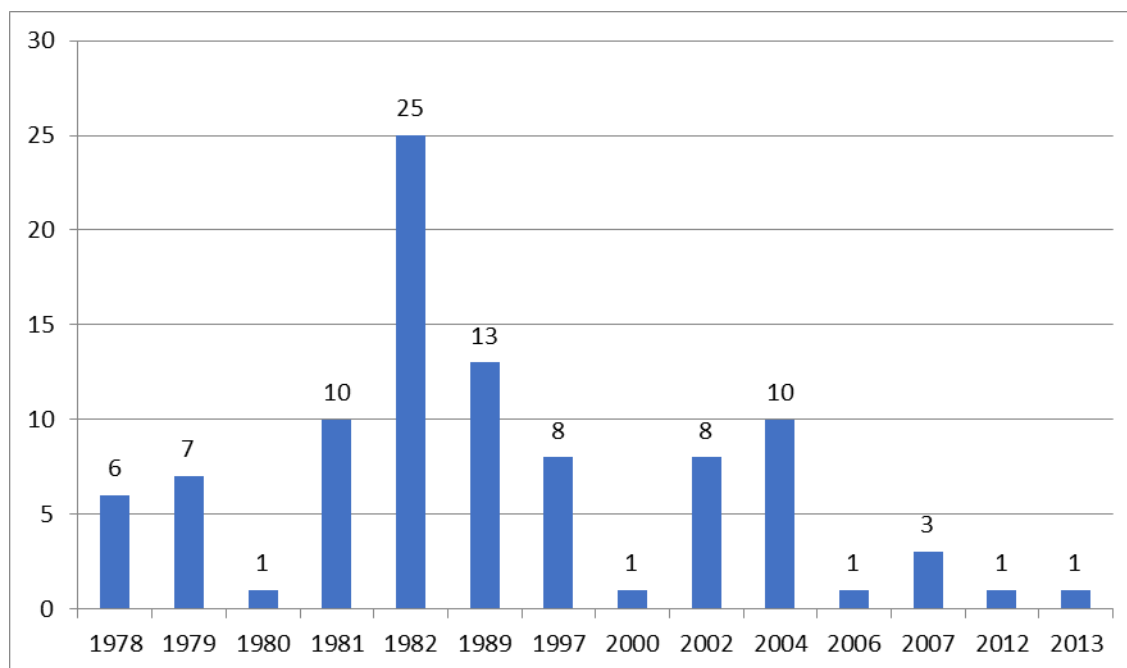
In S2ID – Integrated Disaster Information System, after the research for natural disasters involving Floods, Floods and Floods, in the state of Tocantins for all municipalities and available years, information was found from the year 1978 for flood-type disasters, 1974 for flood disasters and 1997 for flood disasters.

The types of documents found to report the disasters that occurred were: AVADAN – Damage Assessment Report, NOPRED – Preliminary Notification of disaster, decree, ordinances, newspaper, Fide – Disaster Information Form,

and others, for other documents. The disaster with the highest number of occurrences in the system was floods, followed by floods and floods.

#### 4.2 OCCURRENCES OF FLOODS

The flood disasters have a total of 81 documents available on s2id, totaling 96 municipal occurrences, distributed in 43 municipalities in the period from 1978 to 2013, the year of the last available occurrence.



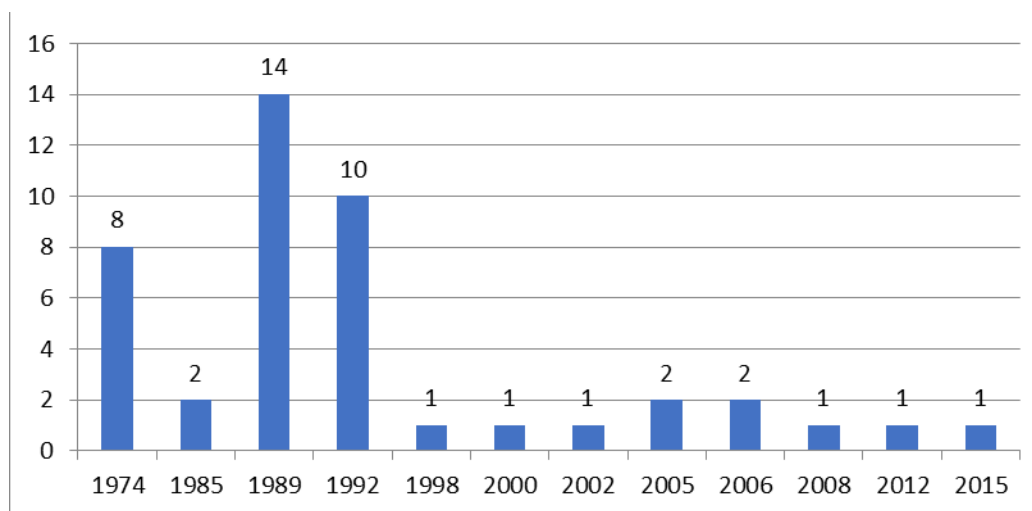
Graph.1: Number of municipalities affected by inundation.

According to graph 1, the year of the largest number of municipalities with flood disaster occurrence was 1982 with a total of 25 municipalities affected.

The municipality with the highest number of occurrences in the period from 1978 to 2013 was the municipality of São Sebastião do Tocantins, with a total of 7 occurrences.

#### 4.3 FLOOD OCCURS

Flood disasters have a total of 49 documents available on s2id, totaling 51 municipal occurrences, distributed in 29 municipalities in the period from 1974 to 2015, the year of the last available occurrence.



Graph.2: Number of Municipalities Affected by Floods.

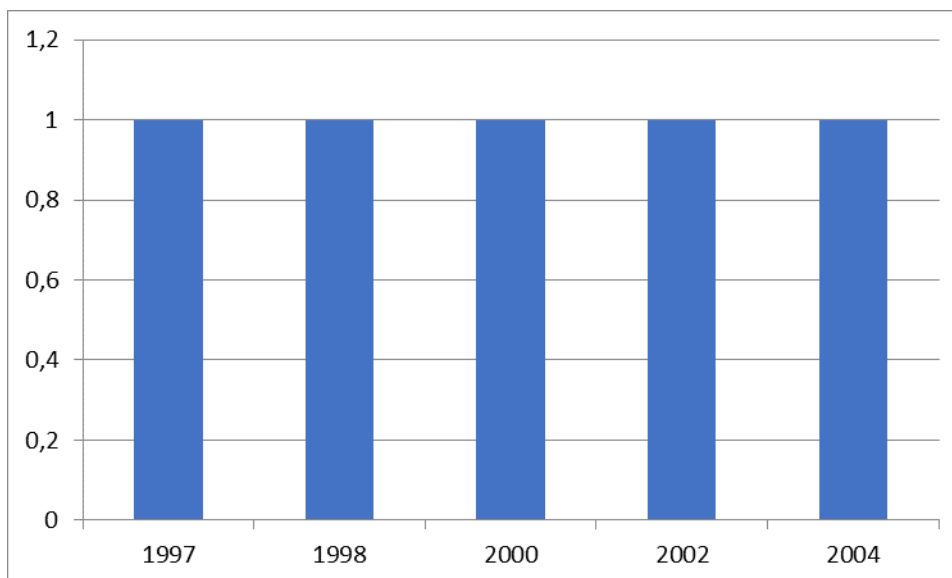
According to graph 2, the year of the largest number of municipalities with flood disaster occurrence was 1989 with a total of 14 municipalities affected.

The municipalities with the highest number of occurrences in the period from 1974 to 2015 were Philadelphia and Babaçulândia, with a total of 4 occurrences each.



#### 4.4 FLOOD OCCURS

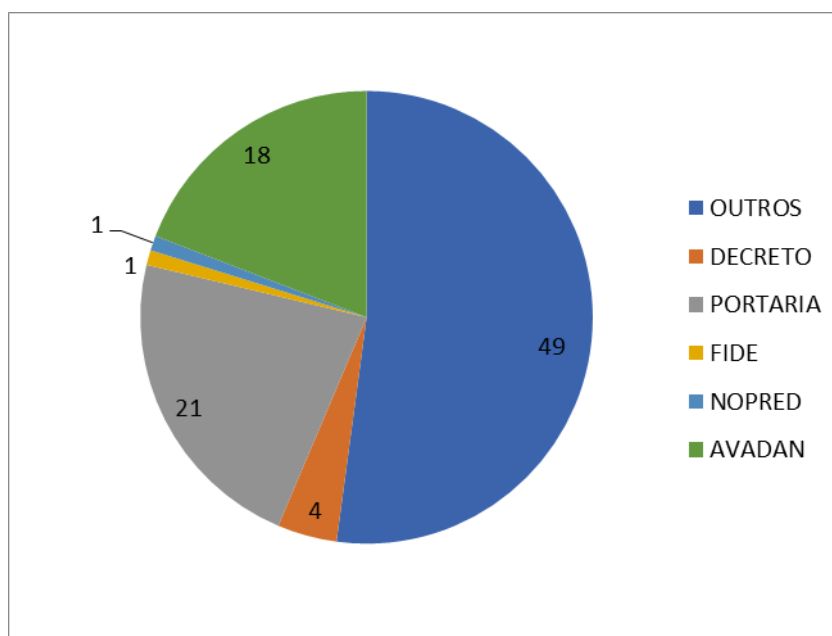
In total, only 5 flood disasters were reported, which occurred in the years: 1997, 1998, 2000, 2002 and 2004, referring respectively to the municipalities of Simolândia, Bernardo Sayão, Esperantina of the Tocantins, Carrasco Bonito Mateiros.



Graph.3: Number of Municipalities Affected by Flooding.

#### 4.5 DOCUMENT TYPES

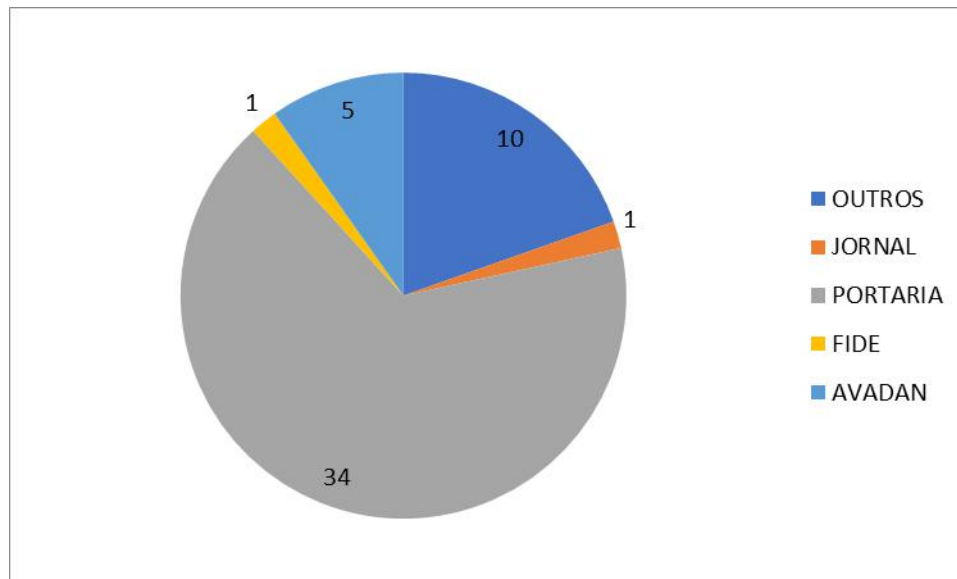
In the occurrences of Floods, from 1978 to 1997 it is possible to find documents of the type decree, ordinances and others, only from the year 2000 it is possible to have access to reports of damage assessment - AVADAN and Preliminary notification of disaster - NOPRED, and a Disaster Information Form - FIDE in 2013.



Graph.4: Documents Inudations.

Graph 4 shows the total of each document type recorded for flood occurrences in the total search period.

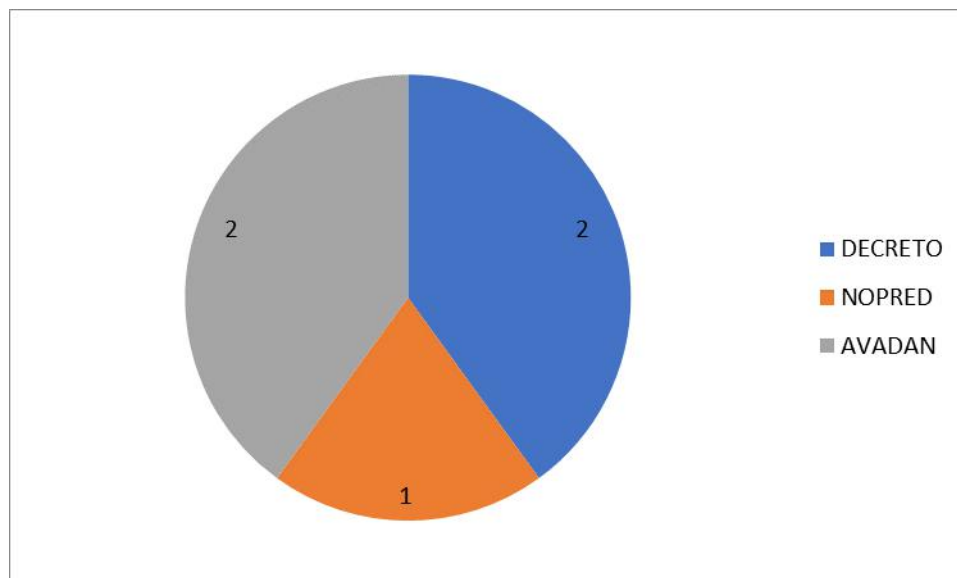
In the occurrences of floods from 1974 to 1998 it is possible to find documents of the type ordinances and others, only from the year 2000 it is possible to have access to reports of damage assessment - AVADAN and Disaster Information Form - FIDE.



Graph 5: Documents Floods.

Graph 5 shows the total of each document type recorded for flood occurrences in the total search period.

The first recorded occurrence of flooding is in 1997 by decree, and from 1998 on, damage assessment reports – AVADAN and Preliminary Disaster Notification – NOPRED are already available.



Graph. 6: Flood Documents.

Graph 6 shows the total of each document type recorded for flooding occurrences in the total search period.

Municipalities monitored via CEMADEN.

Within the scope of the National Risk Management and Disaster Response Plan, CEMADEN currently monitors 959 municipalities in all Brazilian regions that have a history of natural disaster records and risk areas for identified, mapped and georeferenced hydrological and geological processes.

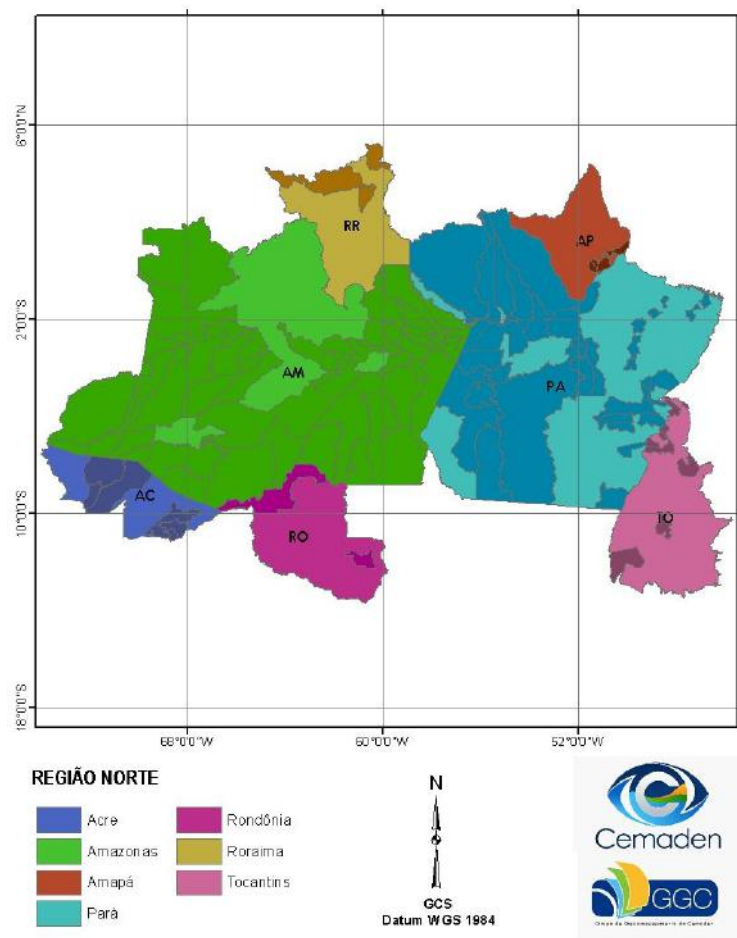


Fig.1: Monitored municipalities of the Northern Region.

Source: CEMADEN

In the state of Tocantins the monitored municipalities are Formoso do Araguaia, Goiatins, Porto Nacional, Santa Fé do Araguaia, São Miguel do Tocantins, São Sebastião do Tocantins, Xambioá, Araguaia, Araguaia, Araguaia.

Municipality	Flood	Flood
Formoso do Araguaia	2	1
Goiatins	2	2
Porto Nacional	3	2
Santa Fé do Araguaia	0	1
São Miguel do Tocantins	3	0
São Sebastião do Tocantins	7	3
Xambioá	4	1
Araguaia	0	3
Araguatins	4	1
Araguaína	1	3

The municipalities monitored by CEMADEN have in common the fact that they are the municipalities with a high number of occurrences of disasters involving Floods and Floods in S2ID, in the period from 1974 to 2015, being listed in table 1.



## V.CONCLUSION

Brazil now has consolidated bodies, which collect data related to the occurrence of natural disasters, headed by the National Secretariat for Protection and Civil Defense (SEDEC), through the National System of Protection and Civil Defense (SINPDEC), and the Tool S2ID - Integrated System of Information on Disasters.

Given the whole context, and data presented, it is possible to relate the importance of obtaining and recording historical data involving natural disasters, because evaluating the occurrences, the places where most occur and the type of disaster, it is possible to map the places of greatest risk of recurrence of the problem, as does CEMADEN - the National Center for Monitoring and Alerting Natural Disasters, thus allowing the minimization of human and material damage in cases of recurrence, allowing the prior planning of dealing with the occurrences.

In Tocantins, it is possible to relate the results obtained by the S2ID of hydrological disasters, with the municipalities with higher risks involving natural disasters in CEMADEN, due to the effectiveness of the integration process of national disaster prevention programs.

## REFERENCES

- [1] S.M. SAITO. I Escuela De Primavera Sobre Soluciones Espaciales Para El Manejo De Desastres Naturales Y Respuestas De Emergencias - inundaciones. Instituto Nacional De Pesquisas Espaciais – INPE, 2010.
- [2] C.M. FREITAS; A.M. SENA, et. al . Desastres naturais e saúde: Uma análise da situação no Brasil. Jun.2014. Disponível em: <<http://www.cienciaesaudecoletiva.com.br/artigos/desastres-naturais-e-saude-uma-analise-da-situacao-no-brasil/14999?id=14999&id=14999>>. Acesso em: 06 abr. 2021.
- [3] F.A. TASCA; R.F GOERL; M. KOBIYAMA. Prevenção de Desastres Naturais através da Educação Ambiental com ênfase na Ciência Hidrológica. Disponível em:<[http://www.labhidro.ufsc.br/Artigos/Art17-Prevencao\\_de\\_desastres.pdf](http://www.labhidro.ufsc.br/Artigos/Art17-Prevencao_de_desastres.pdf)>. Acesso em 15 de mai. 2021.
- [4] R.F. GOERL; M. KOBIYAMA. Considerações sobre as inundações no Brasil. In: Simpósio Brasileiro de Recursos Hídricos (16: 2005: João Pessoa) Porto Alegre : ABRH, anais 2005. CD-rom. 10p.
- [5] MINISTÉRIO DAS CIDADES/INSTITUTO DE PESQUISAS TECNOLÓGICAS. Mapeamento de riscos em encostas e margens de rios. Brasília: Ministério das Cidades/Instituto de pesquisas Tecnológicas, 2007.
- [6] C.E.M.TUCCI. “Gerenciamento integrado das inundações urbanas no Brasil” in REGA: Revista de Gestão de Água da América Latina, 1(1):59-73. 2004.
- [7] Brasil. (2020). Ministério do Desenvolvimento Regional. Proteção e defesa civil. Sistema Nacional de Proteção e Defesa Civil. Brasília.
- [8] Brasil. (2019). Ministério do Desenvolvimento Regional. Proteção e defesa civil. Sistema Integrado de Informações sobre Desastres - S2ID. Brasília.
- [9] PNUD. Programa das Nações Unidas para o Desenvolvimento. 2021. Disponível em:<<https://www.br.undp.org/content/brazil/pt/home/sustainable-development-goals.html>>. Acesso em 12 mai. 2021.
- [10] ODS Brasil. Objetivos de desenvolvimento sustentável. Objetivo 13 - Ação Contra a Mudança Global do Clima. 2021. Disponível em:<<https://odsbrasil.gov.br/objetivo/objetivo?n=13>>. Acesso em 12 mai. 2021.
- [11] C.A. NOBRE; J.A. MARENGO. Mudanças climáticas em rede: um olhar interdisciplinar. São Paulo: Canal6 Editora, 2017.
- [12] Centro Nacional de Monitoramento e Alerta de Desastres Naturais – CEMADEN. Jul.2011. Apresentação. Disponível em: <<http://www.cemaden.gov.br/apresentacao/>>. Acesso em: 05 abr. 2021.